



**Jet Propulsion Laboratory**  
California Institute of Technology

# Overview of SPRITE: Saturn PRobe Interior and aTmosphere Explorer Concept

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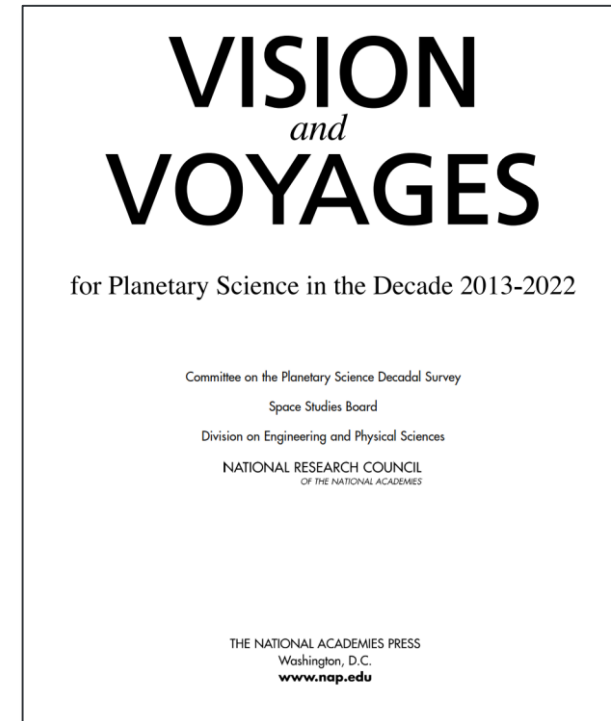
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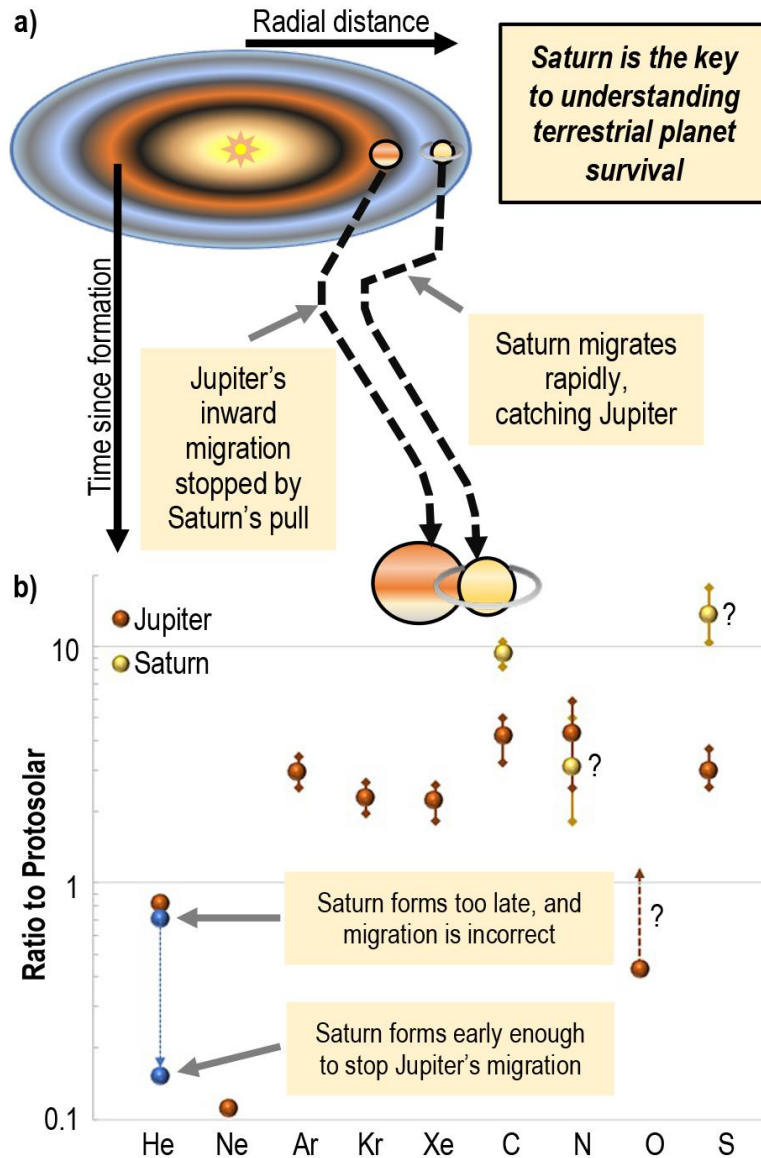
# Saturn Probe Mission Concept – Decadal Survey

- Planetary Sciences Decadal Survey
  - Saturn Probe mission one of several recommended Medium-class missions for New Frontiers program
- Objectives
  - 1: Determine Saturn's Role in Solar System Formation and Evolution
    - Measure noble gas abundances and isotopic ratios in Saturn's atmosphere
  - 2: Characterize Saturn's atmosphere structure and composition
    - Measure atmospheric structure and cloud properties at Probe descent location



***SPRITE is proposed as a New Frontiers candidate mission to address these high-priority Decadal Survey objectives***

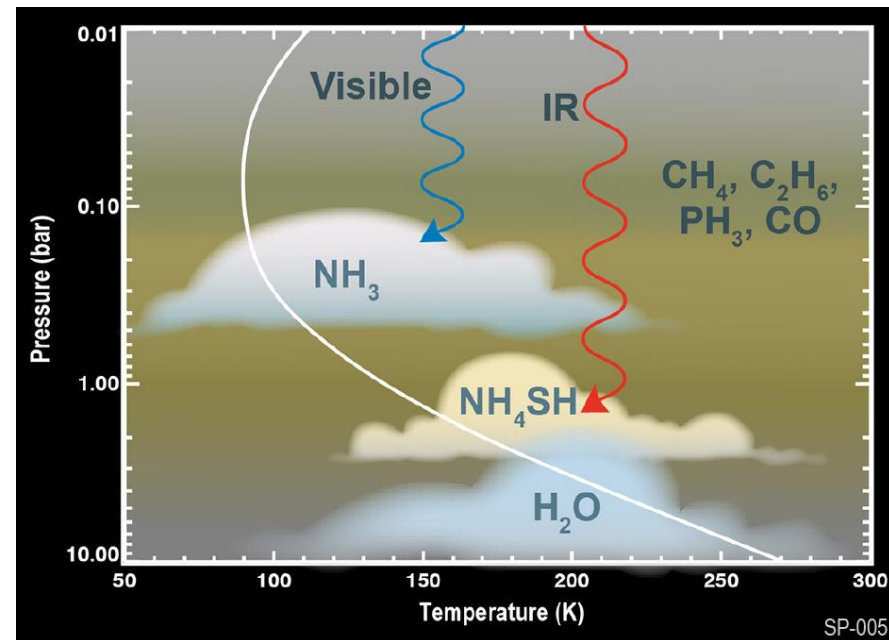
# Saturn's Role in Solar System Formation



- Did Saturn arrest Jupiter migration to inner solar system?
  - In situ measurements will help identify Saturn's age and formation location
  - Sample elemental abundances and isotopic ratios from 0.2 to 10 bars pressure

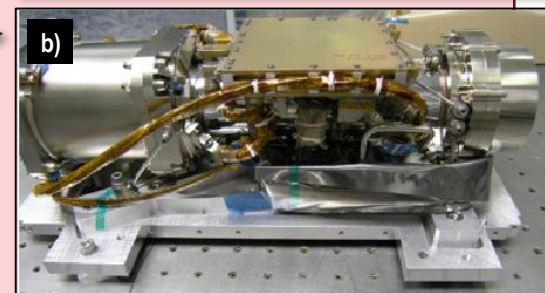
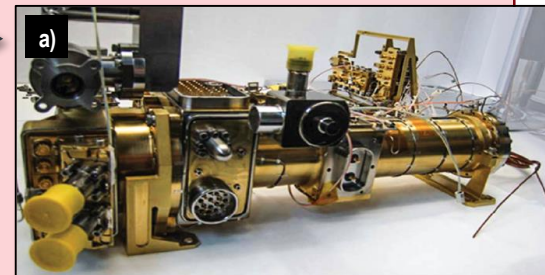
# Truth Beneath Saturn's Clouds

- What are the properties and locations of Saturn's various cloud layers? What are vertical profiles of pressure, temperature, and zonal winds? What processes drive the dynamics and circulation?
  - Remote sensing can only penetrate to cloud tops
  - In situ measurements required to accurately determine Saturn's atmosphere properties and dynamics



# SPRITE Concept – Instrument Suite

- QMS – Quadrupole Mass Spectrometer (GSFC) →
  - Measure noble gas and elemental abundances; key isotopic ratios
- TLS - Tunable Laser Spectrometer (JPL) →
  - Measure noble gas and key elemental abundances; abundance profiles of disequilibrium species
- ASI - Atmospheric Structure Instrument (ARC)
  - Measure *g*-loads during entry, and pressure/temperature during descent
  - Determine atmospheric structure to 10-bar pressure, including vertical profile of horizontal and vertical winds
  - Determine cloud altitudes and measure optical depth



**PROBE  
INSTRUMENTS**

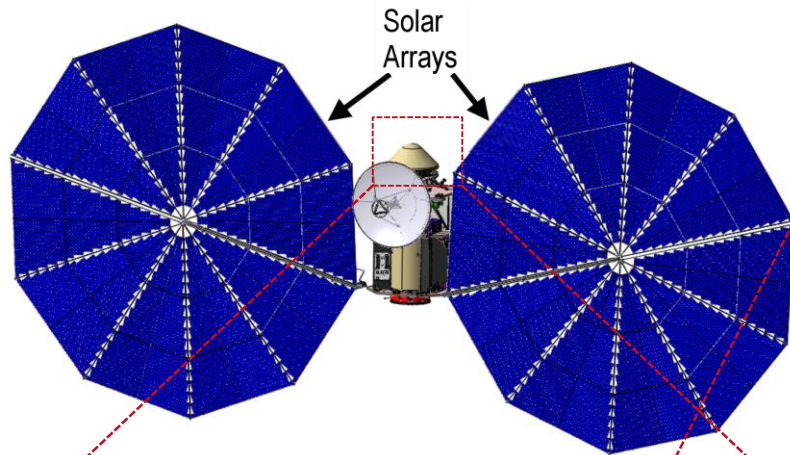
- MCI – Multi-Channel Imager
  - Provide context imaging for in situ measurements prior to entry

**CARRIER SPACECRAFT INSTRUMENTS**

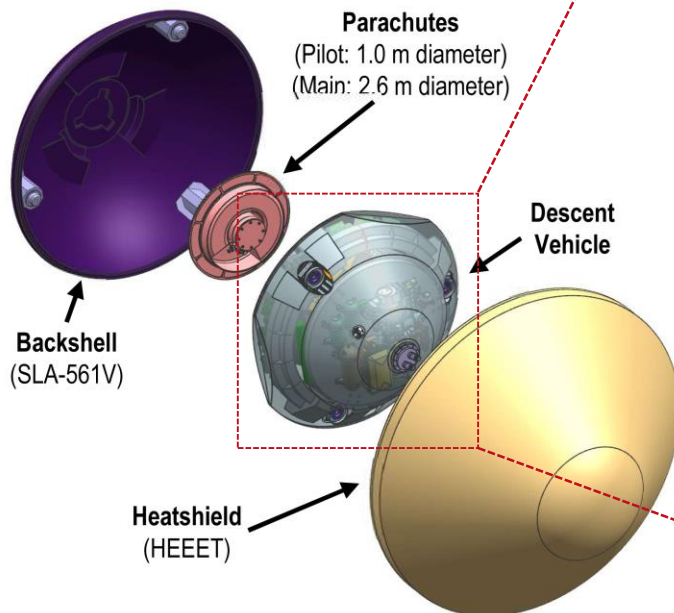


# SPRITE Concept – Flight Elements

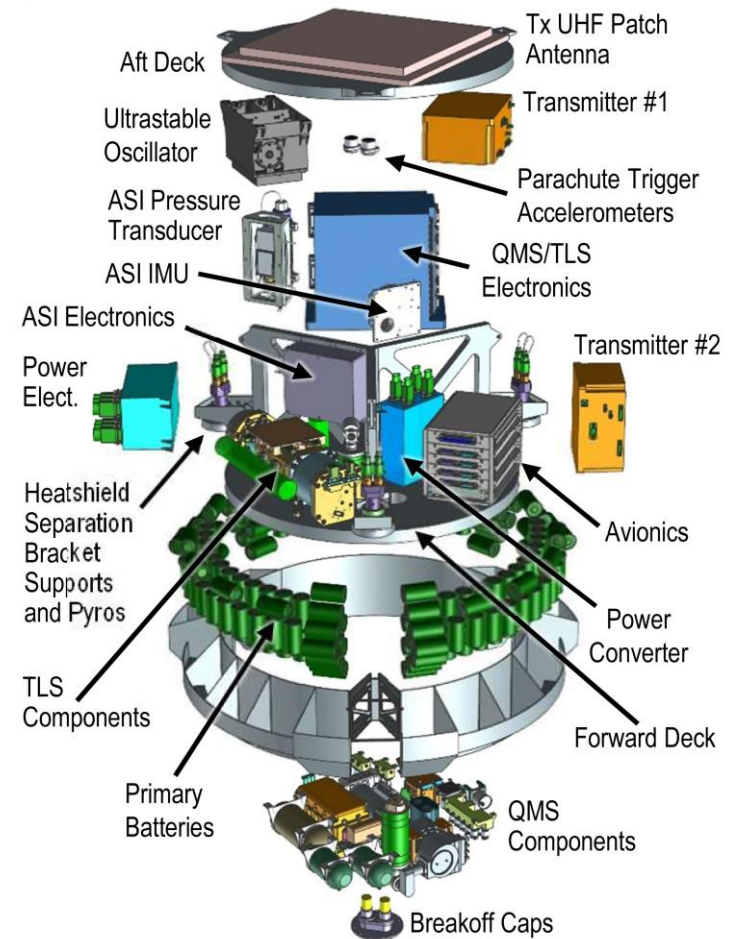
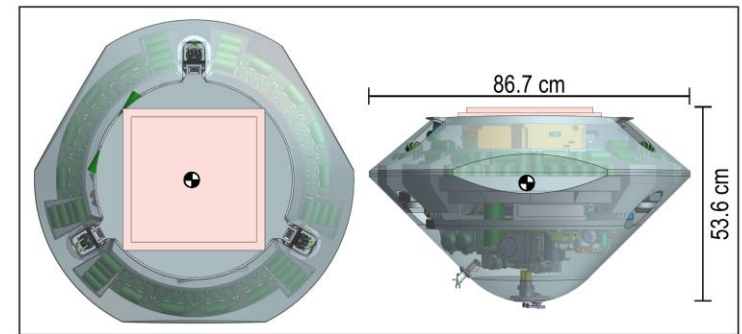
## CARRIER-RELAY SPACECRAFT



## AEROSHELL

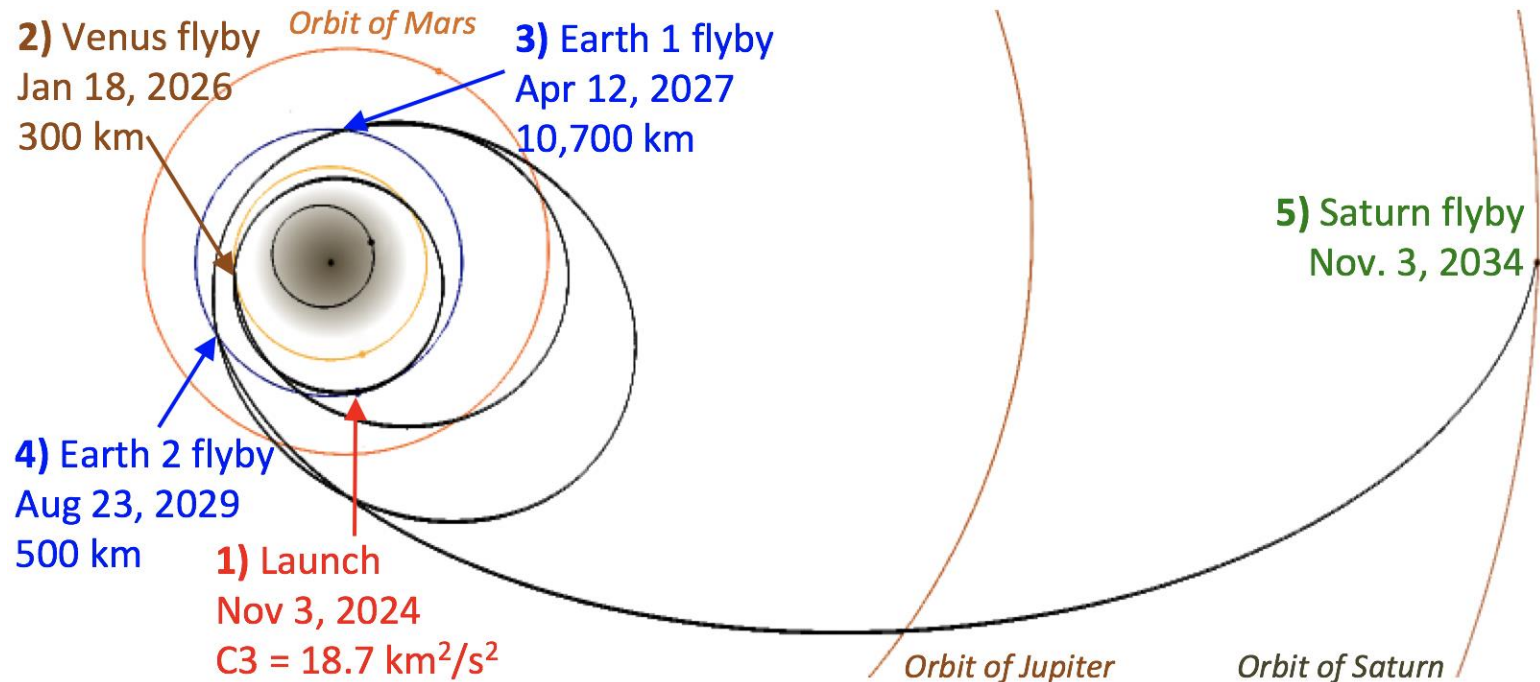


## DESCENT VEHICLE

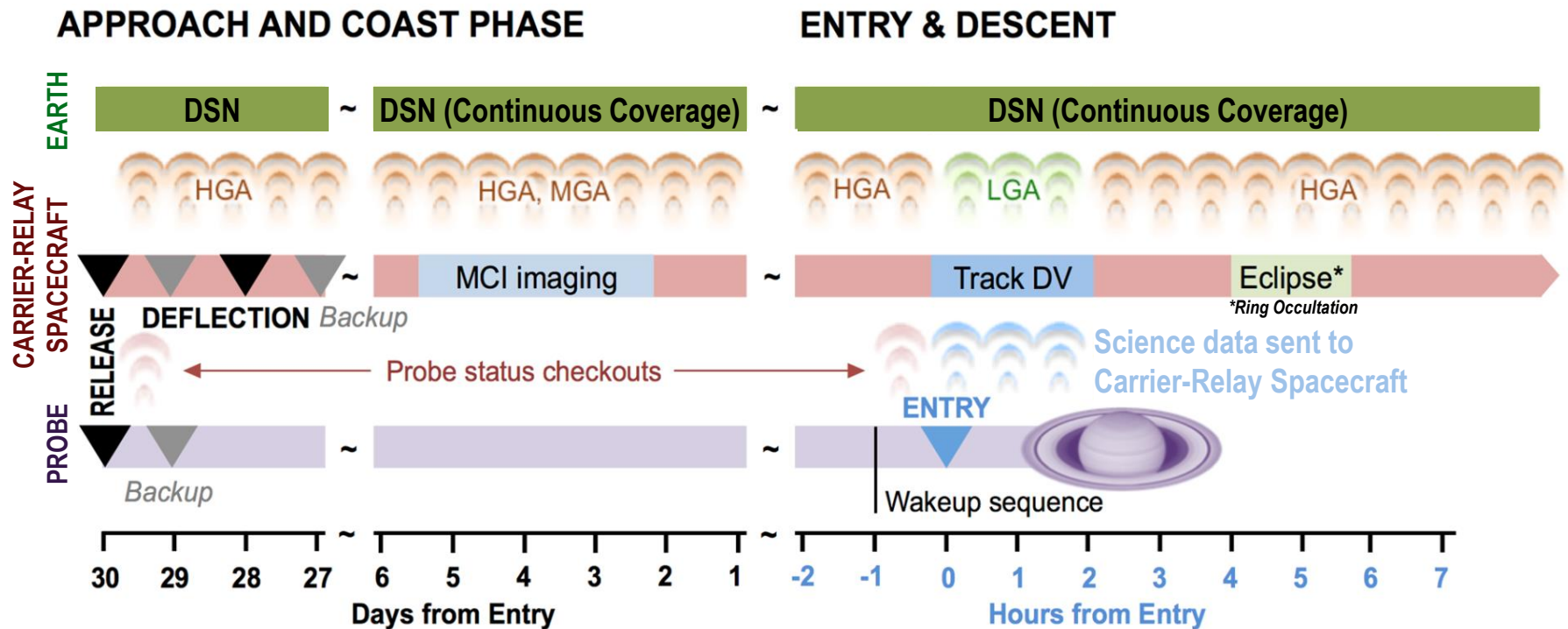


# SPRITE Concept – Launch and Interplanetary Cruise

- Low-intermediate launch vehicle (Atlas V 401 or equiv.)
- Venus-Earth-Earth Gravity Assist trajectory
- 10-year cruise to Saturn using chemical propulsion



# SPRITE Concept – Saturn Approach, Coast, Entry, and Descent

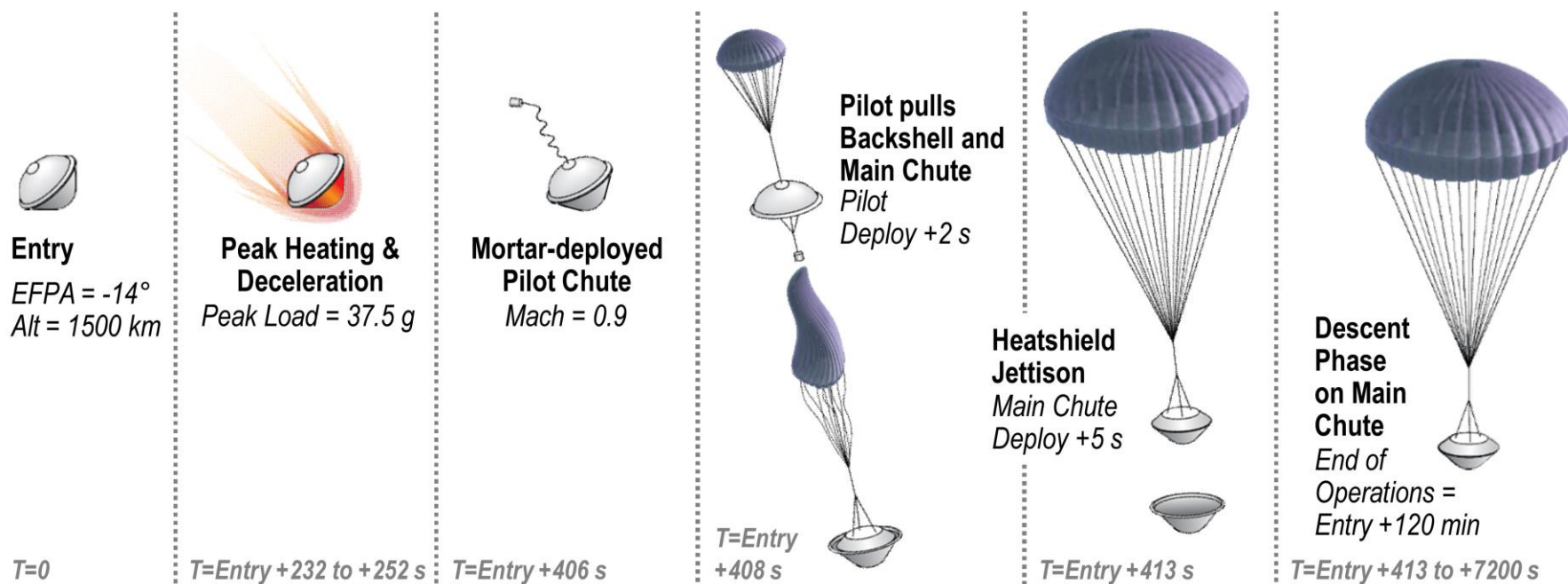


*Saturn approach through entry/descent sequences well-planned out to ensure robust science operations and data return to Earth*



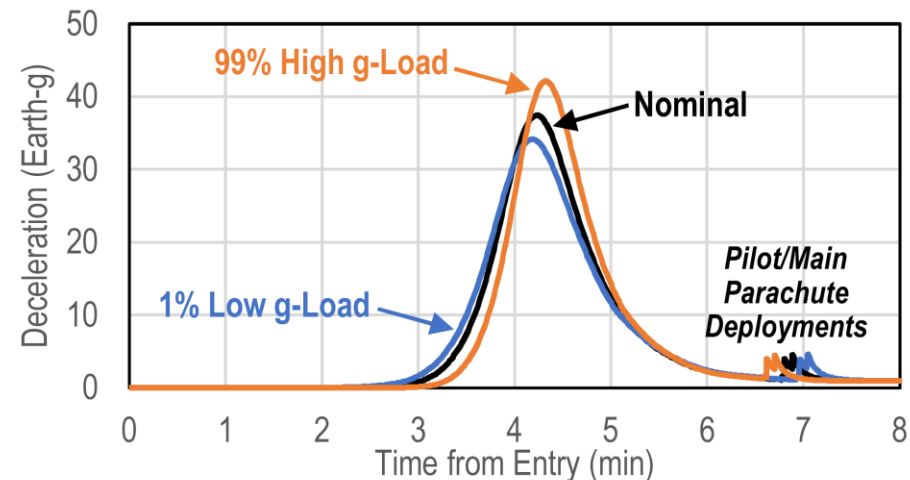
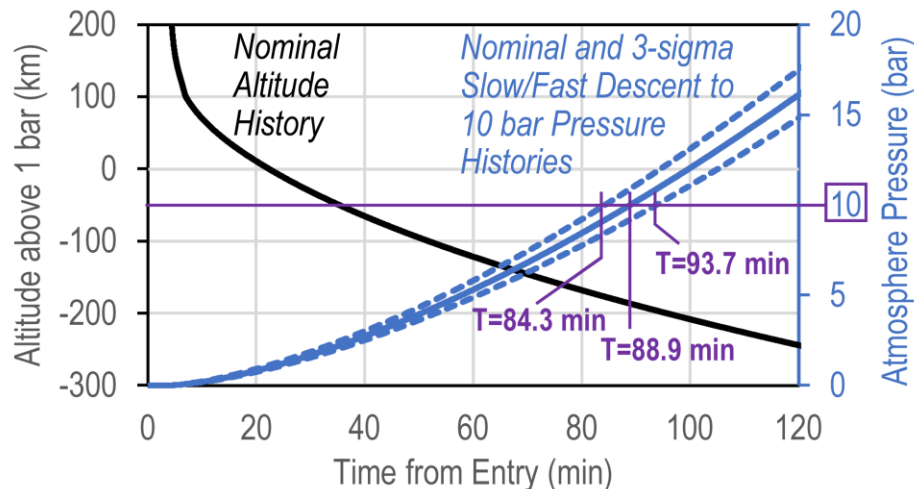
# SPRITE Concept – Entry and Descent

- Follows similar entry concept to Galileo Probe
  - Subsonic Pilot and Main Chute
  - 45-deg sphere-cone Heatshield with spherical Backshell

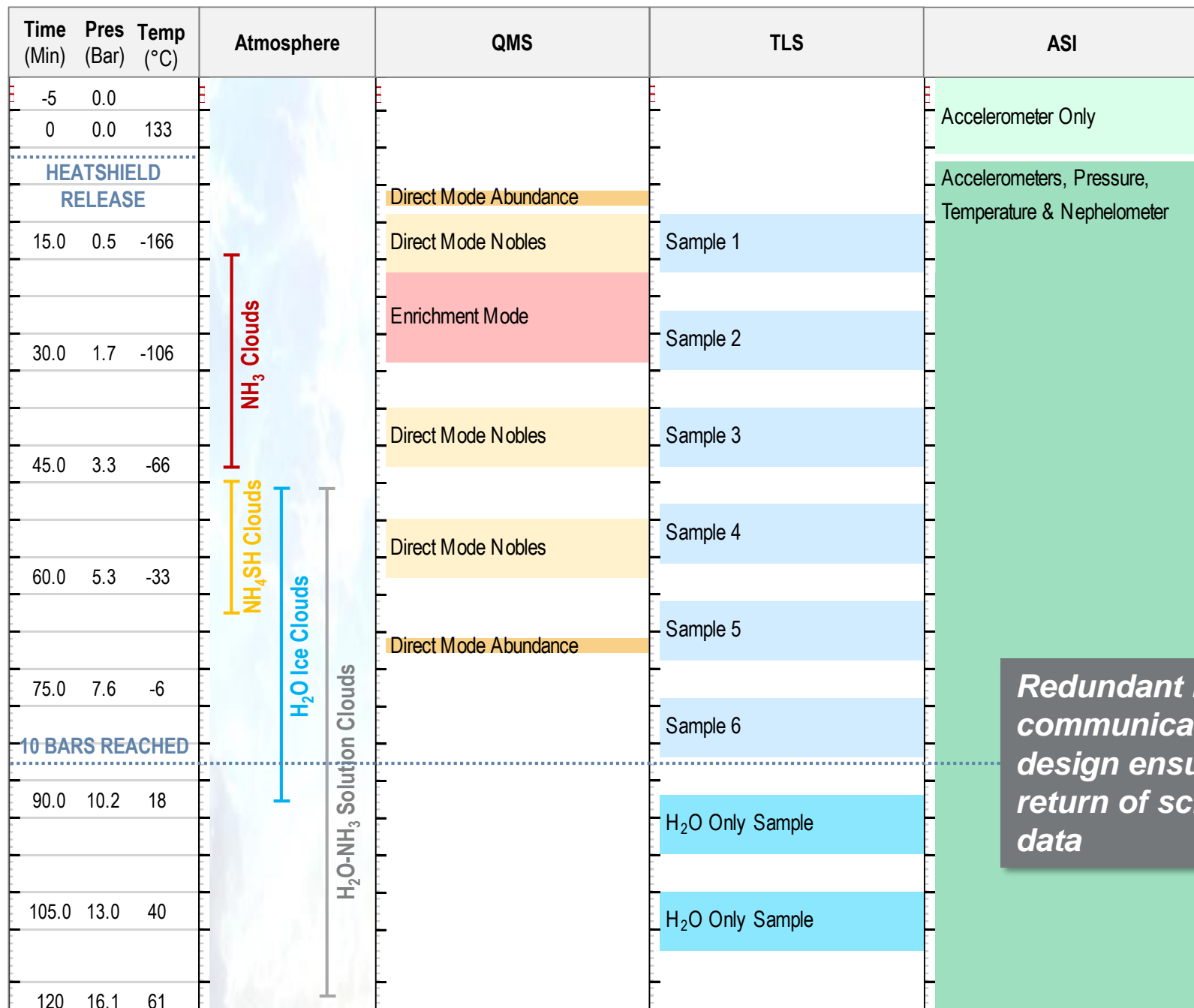


# SPRITE Concept – Entry and Descent, continued

- Descend to 10 bars in ~90 min
  - But designed for 120 min entry/descent ops
- Peak entry deceleration  $\leq 50$  g
- Redundant Probe and Carrier subsystems
- Science data relay back to Carrier via UHF



# SPRITE Concept – Sampling Strategy



*Redundant relay communications design ensures return of science data*

# SPRITE Concept Fulfills Decadal Saturn Probe Objectives

PSDS Highest Priority Science Objectives	SPRITE
1. Determine the noble gas abundance and isotopic ratios of H, C, N and O in Saturn's atmosphere.	✓ Complete
2. Determine the atmospheric structure at the probe descent location.	✓ Complete
PSDS Lower Priority Science Objectives	SPRITE
1. Determine the vertical profile of zonal winds as a function of depth at the probe descent location(s).	✓ Complete
2. Determine the location, density, and composition of clouds as a function of depth in the atmosphere.	✓ Complete
3. Determine the variability of atmospheric structure and presence of clouds in two locations.	✓ Complete
4. Determine the vertical water abundance profile at the probe descent location (s).	✓ Complete
5. Determine precision isotope measurements for light elements such as S, N, and O found in simple atmospheric constituents.	✓ Complete

PSDS = Planetary Science Decadal Survey

Predecisional information for planning and discussion only

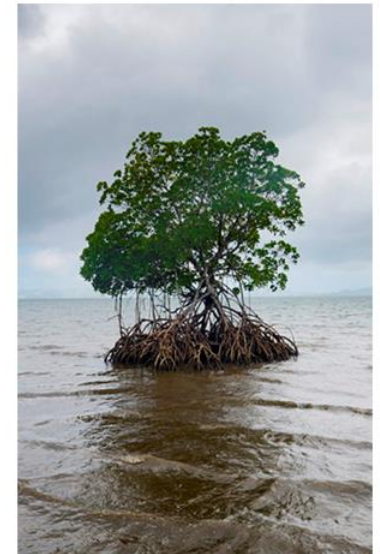
## Saturn Mission Unlocks Planet's Role in Solar System Formation



By Miranda Tyson

SAN FRANCISCO - Scientists from NASA's Jet Propulsion Laboratory and Goddard Space Flight Center unveiled exciting discoveries today on the formation of the Solar System. Dr. Amy Simon, Principal Investigator of the SPRITE Mission which successfully flew by Saturn last month, made the announcement today at the annual meeting of the American Geophysical Union. "The missing link in solar system formation

## NOAA Studies of Sea Level Rise Needed into Next Decade for Disaster Support



By DENNIS OVERBYE, Jr.

Researchers at the National Oceanic and Atmospheric Administration have concluded that the exchange of water stored on land with polar glaciers and ice sheets has reached stable equilibrium. The announcement comes amidst continued catastrophic flooding of the Maldives, Jamaica, and Qatar. The Netherlands has





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